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Assessment of changes in wood anatomical traits to forecast drought-induced dieback in Mediterranean oak forests

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Some tree species have shown to be very vulnerable to drought and heat waves in the Mediterranean Basin, causing a loss of important socio-economic and ecosystem forest services. In this regard, oaks are important but vulnerable species which are showing losses in terms of productivity and growth and rising mortality rates. Dendroecological studies using retrospective analysis of wood anatomical traits and tree rings have demonstrated their potential to assess long-term patterns of growth and vigor in several Mediterranean oak species. Moreover, the long-term reconstruction of wood anatomical traits such as transversal lumen area, allows investigating hydraulic adjustments of trees through time.

In this study, we reconstructed changes in wood anatomy for a 38-year long period (1980-2017) to investigate how drought impacted the hydraulic functionality and triggered dieback in five ring-porous oak species from Italy and Spain (*Quercus robur, Quercus frainetto, Quercus cerris*, *Quercus canariensis, Quercus pubescens*). We compared non-decaying (ND) and decaying (D) coexisting trees of each species showing low and high defoliation levels, respectively. We analyzed earlywood anatomical traits (vessel area, hydraulic diameter, vessel density, theoretical hydraulic conductivity, etc.) in these species and analysed them considering a ranking of increasing drought tolerance: *Q. robur, Q. frainetto, Q. cerris*, *Q. canariensis,* and *Q. pubescens*.

We observed differing growth patterns and xylem conduit area responses in D trees compared with ND trees. The D trees formed narrower EW vessels than ND and the Dh were lower in D trees compared with ND trees. We discuss the relationships between radial growth, changes in wood anatomy and hydraulic functioning of trees focusing on those proved more sensitive to growth decline and mortality in order to highlight the climatic triggers of dieback in ring-porous oak species as related to hydraulic failure.